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AGENCY**

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OFFICE OF CHEMICAL SAFETY
AND POLLUTION PREVENTION

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MEMORANDUM

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SUBJECT: Chlorpropham Drinking Water Assessment for Registration Review

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1 EXECUTIVE SUMMARY

This memo summarizes estimated drinking water concentrations (EDWCs) of chlorpropham (PC Code 018301, propan-2-yl N-(3-chlorophenyl)carbamate) residues of concern in surface water and in groundwater in support of Registration Review of chlorpropham. Chlorpropham is a carbanilate plant growth regulator used for post-harvest treatment of potatoes and for special local needs on Ginkgo trees (*Ginkgo biloba*) in the District of Columbia and field grown Easter lilies (*Lilium longiflorum*) in California and Oregon. Residues of concern include parent chlorpropham and its degradate 3-chloroaniline. EDWCs were calculated for total toxic residues consisting of parent plus 3-chloroaniline. While separate EDWC for parent and 3-chloroaniline were originally requested because 3-chloroaniline has potential carcinogenic properties are not associated with the parent molecule. However, fate data were not sufficient to calculate a separate value for 3-chloroaniline alone when unextracted residues were excluded.

The only outdoor use patterns of chlorpropham expected to result in residues in drinking water involve the use of chlorpropham on Easter lilies in Del Norte county in California and Curry county in Oregon. Based on historical contamination from application of pesticides to lily bulbs to control nematodes, the groundwater in these areas is vulnerable to contamination from surface-applied chemicals (USEPA, 2002, D283433). The EDWCs for both surface water and groundwater recommended for use in HED's human health dietary risk assessment are summarized in **Table 1**. The highest groundwater concentrations were higher than the highest concentrations estimated for surface water. The maximum EDWCs of chlorpropham plus 3-chloroaniline residues recommended for use in the human health dietary risk assessment are **121.0 µg/L** for acute exposure, and **73.4 µg/L** for chronic and cancer exposures (**Table 1**). These EDWCs are higher than those previously estimated¹, primarily due to newly-available aerobic soil metabolism and soil sorption data.

There is a degree of uncertainty in the EDWCs because unextracted residues in the aerobic soil metabolism studies reached as high as 97% of applied radioactivity in aerobic soil metabolism studies, and the identity of these residues in the aerobic soil metabolism studies is unknown (some or all of it may consist of chlorpropham and/or 3-chloroaniline). However, information from a number of published studies suggests that chlorpropham and substituted anilines tend to bind to soils strongly and perhaps irreversibly. In light of this information unextracted residues were not included in aerobic soil decay kinetic calculations, thus the EDWCs implicitly do not include them. Other sources of uncertainty include the fact that aquatic metabolism and photolysis degradation studies are not available.

Table 1. EDWC for Chlorpropham Plus 3-Chloroaniline Based on Use on Easter Lilies

Source of Drinking Water	EDWC (µg/L)		
	Acute	Chronic	Cancer
Surface	82.5	64.4	46.3

¹ In the previous drinking water assessment, chlorpropham concentrations were estimated to be 100 µg/L and annual average 3-chloroaniline concentrations were estimated to range from 0.2 to 8 µg/L, depending on the half-life and K_{oc} assumed in modeling (USEPA, 2002, D283433). Data from newly-submitted aerobic soil metabolism studies include sufficient information to estimate degradation kinetics for chlorpropham plus 3-chloroaniline.

Groundwater	121.0	73.4	73.4
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2 REGISTERED USES

Chlorpropham is currently registered for use as a plant-growth regulator to inhibit sprouting of stored potatoes. For this use pattern, application occurs indoors. While some residues of chlorpropham may thus go down the drain, it was assumed that the outdoor uses would result in higher EDWCs; therefore, EDWCs were not calculated for indoor uses. Chlorpropham is also registered under Special Local Needs (SLN) Section 24c registrations for use on Ginkgo trees in the District of Columbia, and for field-grown Easter lilies in California and Oregon.

There are two uses of chlorpropham on stored potatoes, one being an aerosol thermal fogger used to treat potatoes in warehouses, and the other being a spray treatment applied to potatoes prior to storage or shipment; both application methods are indoor uses. The use as an aerosol fogger requires a forced air application, which may involve application through the ventilation system. The application rate varies by label, but ranges from one pound per 400 hundred weight (cwt) to 600 cwt of potatoes. The use as a spray on potatoes is limited to a 1% emulsion applied to potatoes on a conveyor belt. This use is limited to indoors and the label specifies 'Do not apply in the field'. The estimated chlorpropham concentration in the spray applied to potatoes is approximately 10 g chlorpropham per liter solution (10,000 mg/L) based on the use described for the emulsifiable concentrate SHIELD potato sprout inhibitor (EPA registration number 2749-70)². It is possible that the solution would go down the drain of a potato processing facility and there could be movement of residues into surface water; however, preliminary analysis (see Appendix C) indicates that the EDWC from this proposed pathway would be lower than EDWCs for Easter lilies.

The use on Ginkgo trees in DC specifies only that one gallon product (3 lbs a.i.) per 151.5 gallons of water be used. It is unclear how much product is applied per tree; the label states that the mixture is applied with a mist blower to 'nearly the point of runoff'. Application is intended to occur three weeks after pollination 'when young fruit is responsive'. Although not specified, the label implies a single application. The application typically happens the second week of May.

The use on Easter lilies consists of a ground spray application of 3 to 4 lbs a.i./A in a single application. Full cone flood jet nozzles are specified at 20-30 psi. Nozzle height is also specified as 10-14 inches above plant tops. Split application with half the application rate applied at one week intervals is permitted.

A summary of currently registered chlorpropham uses, along with their respective methods and rates of application is presented in **Table 2**. In 1996 there were 465,000 lb of chlorpropham applied. Of this, 300 lb were applied to Ginkgos, and no more than 600 lb applied to Easter lilies, the balance was applied to potatoes (USEPA, 2010, D378555). The potato treatment uses

² The label specifies to dilute add 1 gallon of product to 24 gallons of water and apply the solution to potatoes after agitation. One gallon of product contains 2 lbs a.i. which results in 0.083 lbs a.i./gallon water. This converts to 9981 mg a.i./L product.

of chlorpropham are permitted anywhere in the United States.

Table 2. Maximum Use Patterns for Current Chlorpropham Uses

Use Pattern	Formula	Single App. Rate (lbs a.i./A)	Number of App.	Seasonal App. Rate (lbs a.i./A)	App. Interval (days)	Application Method	Comments
Stored potatoes	Liquid or Briquette	NA	1/cwt	NA	NA	Indoor aerosol fogger	Applied under positive pressure via thermal aerosol generator
Stored potatoes	Emulsifiable concentrate 36% a.i.	NA	NA	NA	NA	Indoor fixed point spray	
Ginkgo	Emulsifiable concentrate 36% a.i.	NS	NS	NS	NS	Mist blower	May only be applied in Washington D.C.
Easter lilies	Emulsifiable concentrate 36% a.i.	4 (2)*	1 (2)	4	7	Ground spray	May only be applied in Curry County, Oregon and Del Norte County, California.

App=application

*Single season application rate may be applied in two applications.

3 ENVIRONMENTAL FATE AND TRANSPORT

Table 3 summarizes the identity information and physical-chemical properties of chlorpropham. Based on its vapor pressure, water solubility, log octanol-water partition coefficient (K_{OW}), and soil-water distribution coefficients (K_d), chlorpropham is classified as having an intermediate to high volatility under field conditions and being slightly volatile from water (OPPTS Guideline 835.6100 classification system). Based on chlorpropham's log K_{OW} value of 3.43³, and log octanol-air partition coefficient (K_{OA}) values of 5, it is expected to have some potential to bioconcentrate, bioaccumulate, or biomagnify in organisms.⁴ Bioconcentration in the terrestrial environment will however likely be attenuated somewhat by the short predicted atmospheric half-life (estimated atmospheric half-life of 0.27 days, **Table 5**). Compounds with a log K_{OW} of three and above are generally considered to have the potential to bioconcentrate in aquatic organisms. Measured bioconcentration data are not available for chlorpropham. The EpiSuite estimate for the bioconcentration factor is 96 L·kg⁻¹ wet-weight, which is not within the range where bioconcentration and/or bioaccumulation would be of concern.

³ Compounds with a log K_{OW} of three and above are generally considered to have the potential to bioconcentrate in aquatic organisms.

⁴ A recent scientific advisory panel (SAP) reported, "Gobas *et al.* (2003) concluded that chemicals with a log K_{OA} > 5 can biomagnify in terrestrial food chains if log K_{OW} > 2 and the rate of chemical transformation is low. However, further proof is needed before accepting these limits without reservations" (SAP, 2009). This was also supported by Armitage and Gobas's work completed in 2007 (Armitage and Gobas, 2007).

Table 3. Summary of Physical-chemical Properties of Chlorpropham¹

Parameter	Value and Units	Source and/or Comment
PC Code	018301	--
CAS Number	101-21-3	--
SMILES Code	<chem>CC(C)OC(=O)Nc1cccc(Cl)c1</chem>	--
Chemical Name	Chlorpropham	--
Empirical Formula	C ₁₀ H ₁₂ NO ₂ Cl	--
Molecular Weight	213.66 g/mole	--
Water Solubility at 25°C (mg/L)	165.5	42737401
Vapor Pressure	1.84 x 10 ⁻⁴ torr at 25° C 6.02 x 10 ⁻⁴ torr at 35° C 1.99 x 10 ⁻³ torr at 45° C	42772401 Intermediate to high volatility under field conditions
Henry's Law constant at 25°C	3.12 x 10 ⁻⁸ atm·m ³ ·mol ⁻¹	Estimated from vapor pressure and water solubility at 25°C.
Log Dissociation Constant (pK _a)	No dissociation	(AERU, 2012)
Octanol-water partition coefficient (K _{ow}) at 25°C	2.7 x 10 ³ at 25° C Log K _{ow} =3.43	42737401
Air-water partition coefficient (K _{AW})	4×10 ⁻⁵ (log K _{AW} = -5)	Estimated from vapor pressure and water solubility at 25°C Slightly volatile from water.
Octanol-air partition coefficient (K _{OA})	2×10 ⁸ (log K _{OA} = 8)	Estimated from K _{AW} and K _{ow} .

¹All estimated values were estimated according to "Guidance for Reporting on the Environmental Fate and Transport of the Stressors of Concern in Problem Formulations for Registration Review, Registration Review Risk Assessments, Listed Species Litigation Assessments, New Chemical Risk Assessments, and Other Relevant Risk Assessments" (USEPA, 2010). Classifications systems are also listed in the same citation.

3.1 Transformation Rates in Laboratory Studies

Table 4 summarizes abiotic and biotic transformation data. Chlorpropham is stable to hydrolysis. Aerobic soil metabolism results are somewhat uncertain due to high levels of unextracted residues (up to 97% applied radioactivity in one soil), and because a sufficient range of nonpolar and polar solvents was not employed at all sampling intervals to demonstrate that the extraction procedure was adequate. Aerobic soil half-lives for parent chlorpropham ranged from 1.7 to 11 days in eight soils, while half-lives for parent + 3-chloroaniline in the same soils ranged from 2.2 to 30 days. Various published studies provide evidence that high unextracted residues are to be expected, for example reporting that chlorpropham is near the top of the list of pesticides in terms of percentage of residues bound to soil (Barriuso *et al.*, 2008; Sun and Lee, 2003), and that anilines in general bind to soil as an apparent consequence of the formation of covalent bonds to functional groups in soil organic matter (Bollag *et al.*, 1978; Bollag *et al.*, 1983; Parris, 1980; Thorn *et al.*, 1996).

Chlorpropham degradate 3-chloroaniline is considered to be a residue of concern for human health (in drinking water). Besides 3-chloroaniline, three minor degradates (*i.e.*, present at less

than 10% of applied radioactivity) were also observed in one aerobic soil metabolism study. Data are not available on the aquatic metabolism, soil photolysis, or aqueous photolysis of chlorpropham.

Table 4. Abiotic and Biotic Transformation Kinetics of Chlorpropham

Study	System Details (Kinetic Equation)	Representative Half-life to Derive Model Input (days) ²	Reference Or (MRID), Study Classification And Comments
Hydrolysis (50°C)	pH 4	Stable	MRID 00114729
	pH 7		
	pH 9		
Atmospheric Degradation	Hydroxyl Radical (SFO)	Not applicable	Estimated using EPIWEB v.4.1 for 12-hour day, 1.5×10^5 OH- molecules/cm ³ . Chlorpropham is not expected to undergo long range transport in the vapor phase. ²
Aerobic Soil Metabolism (20°C)	North Dakota Loamy sand soil 20°C, pH 5.4 (SFO, SFO*)	8.51 8.94*	MRID 49576601. Supplemental due to high levels of unextracted residues (up to 97% of applied) and a range of polar and nonpolar solvents was not explored to determine whether the extraction procedure as adequate.
	North Dakota Sandy clay loam soil 20°C, pH 6.6 (IORE, SFO*)	1.64 2.24*	
	North Dakota Clay loam soil 20°C, pH 5.3 (IORE, SFO*)	11 12.1*	
	North Dakota Sandy clay loam soil 20°C, pH 7.8 (IORE, DFOP*)	1.7 3.91*	
Aerobic Soil Metabolism (20°C)	North Dakota Loamy sand soil 20°C, pH 5.5 (SFO)	26.3 29.9**	MRID 49961902. Supplemental due to high levels of unextracted residues (up to 85% of applied) and a range of polar and nonpolar solvents was not explored to determine whether the extraction procedure as adequate.
	North Dakota Sandy clay loam soil 20°C, pH 6.2 (SFO)	7.11 15.8**	
	North Dakota Sandy loam soil	3.57	

	20°C, pH 6.7 (SFO)	
	North Dakota Sandy loam soil 20°C, pH 6.3 (SFO)	11.2 12.7**

DT_x=time for concentration/mass to decline by X percentage; SFO=single first order; DFOP=double first order in parallel; IORE=indeterminate order (IORE); SFO DT₅₀=single first order half-life; T_{IORE}=the half-life of a SFO model that passes through a hypothetical DT₉₀ of the IORE fit; DFOP slow DT₅₀=slow rate half-life of the DFOP fit

* Value calculated for parent plus 3-chloroaniline.

** Value calculated for total extracted residues as a conservative proxy for parent plus 3-chloroaniline, since values for 3-chloroaniline were not reported.

¹ Half-life values were calculated using nonlinear regression and SFO, DFOP, or IORE equations. The equations can be found in the document, *Standard Operating Procedure for Using the NAFTA Guidance to Calculate Representative Half-life Values and Characterizing Pesticide Degradation* (USEPA, 2012b).

² The value used to estimate a model input value is the calculated SFO DT₅₀, T_{IORE}, or the DFOP slow DT₅₀ from the DFOP equation. The model chosen is consistent with that recommended using the, *Guidance for Evaluating and Calculating Degradation Kinetics in Environmental Media* (NAFTA, 2012). The same kinetic equation used to determine the representative model input value was used to describe the DT₅₀ results based on standard kinetic equations.

3.2 Sorption and Mobility

Soil sorption data were submitted for chlorpropham (MRID 49643901). The K_d and K_{OC} for adsorption of the compound to four soils ranged from 0.18 to 1.66, and 21 to 59, respectively. Sorption was determined to be correlated with soil organic carbon (the coefficient of variation of K_{OC} values was less than that for K_d), and the mean K_{OC} was 33.2 L/kg-OC. Other sorption data were also submitted for chlorpropham and 3-chloroaniline (MRID 49576601 and 49457205); however, these data suggest that equilibrium was not achieved during these studies, and the stability of the test substance was uncertain. The predicted K_{OC} using the Log K_{OW} method (EPIWeb version 4.1) is 88 L/kg-OC for 3-chloroaniline. Based on measured and estimated K_{OC} values, according to the FAO classification system (FAO, 2000) both chlorpropham and 3-chloroaniline are mobile⁵.

One soil column leaching study was submitted (MRID 49457205). The study was considered supplemental due to limited information on soils and lack of storage stability data. Between 57% and 96% of the applied radioactivity (AR) was associated with the 0-6 cm depth soil layer and up to 33% of the AR was associated with the 6-12 cm soil layer. Less than or equal to 1% of applied radioactivity was found in leachate.

4 RESIDUES OF CONCERN

The most recently-completed previous drinking water assessment identified the residues of concern for human health drinking water to be parent chlorpropham and 3-chloroaniline

⁵ The pKa of 3-chloroaniline is 3.52, indicating that this compound will primarily exist in its nonionic form in the environment (NIH, 2016).

(USEPA, 2002, D283433), and separate EDWCs were provided for each individually. There were unextracted residues in the soil metabolism studies at levels high enough to influence EDWCs when the unextracted residues were considered to be residues of concern in calculating degradation half-lives. The chemical composition of the unextracted residues is unknown (*e.g.*, they could include any combination of parent, 3-chloroaniline, and residues that are not of concern). Therefore, to be protective, EDWCs were calculated assuming that the unextracted residues are residues of concern.

In the current assessment a total toxic residue (TTR) approach was used to calculate EDWCs for residues of chlorpropham plus 3-chloroaniline. The degradation kinetic results calculated in this way were used in modeling to estimate EDWCs for total residues. Although evidence of non-carcinogenicity in humans has been observed for chlorpropham, degradate 3-chloroaniline is a structural isomer of a known carcinogen, 4-chloroaniline.⁶ The Agency decided to use the toxicity data for 4-chloroaniline as a surrogate for the toxicity of 3-chloroaniline. Based on the structure of the compounds, the Agency believes that 3-chloroaniline is probably, at most, as toxic as 4-chloroaniline.

5 MODELING APPROACH AND INPUT PARAMETERS

EDWCs were calculated for the following residues of concern: total residues of parent plus 3-chloroaniline

5.1 Models

5.1.1 Pesticides in Water Calculator (PWC) Version 1.52

Exposure estimates were calculated with the recently released Pesticides in Water Calculator (PWC version 1.52). PWC estimates pesticide concentrations in surface water that result from pesticide applications to land. The PWC uses PRZM (PRZM5.02) and the Variable Volume Water Body Model (VVWM v1.02) to estimate concentrations in a generic, representative surface water body. Groundwater EDWCs were also derived using the PWC version 1.52 (Baris *et al.*, 2013). In its groundwater simulation mode, the PWC is a one-dimensional leaching model that accounts for pesticide fate in the crop root zone by simulating transport and degradation occurring throughout the soil profile after a pesticide is applied to an agricultural field. The model permits the simulation of multiple consecutive years of pesticide application (up to 100 years) on a single site. Six standard scenarios, each representing a different region known to be vulnerable to groundwater contamination, are currently available for use with the PWC for risk assessment purposes. In the groundwater simulations for this assessment, all of these standard scenarios were used. PWC outputs represent pesticide concentrations in a vulnerable groundwater supply located directly beneath an agricultural field. Percent Cropped Area adjustment factors (PCAs) are not applied to the results of groundwater modeling.

⁶ <https://archive.epa.gov/pesticides/reregistration/web/pdf/0271fact.pdf>

5.1.2 Percent Cropped Area Adjustment Factor

PCAs account for the maximum percent area within a watershed that may be planted with a modeled crop. They are applied to concentrations predicted by the PWC for surface water, in accordance with the *Guidance on Development and Use of Percent Cropped Area Adjustment Factors in Drinking Water Exposure Assessments* (USEPA, 2012a, 2014a). Chlorpropham has uses on Gingko and Easter lilies, but a PCA was not developed for these use patterns. Therefore, a PCA adjustment was not applied to the EDWCs generated using the PWC.

5.2 Input Parameters

A summary of the 'chemical tab' model input parameter values used in PWC is presented in **Table 5**. Input parameters were selected in accordance with EFED's:

- *Guidance for Selecting Input Parameters in Modeling the Environmental Fate and Transport of Pesticides* Version 2.1 (USEPA, 2009);
- *Guidance for Selecting Input Parameters for Modeling Pesticide Concentrations in Groundwater Using the Pesticide Root Zone Model,"* Version 1 (USEPA and Health Canada, 2013);
- *Guidance on Modeling Offsite Deposition of Pesticides Via Spray Drift for Ecological and Drinking Water Assessment* (USEPA, 2013);
- *Standard Operating Procedure for Using the NAFTA Guidance to Calculate Representative Half-life Values and Characterizing Pesticide Degradation. Version 2.* (USEPA, 2015b); and
- *Guidance for Using the Volatilization Algorithm in the Pesticide in Water Calculator and Water Exposure Models.* (USEPA, 2015a)

Scenario and application parameter inputs are shown in the results **Table 6**.

Scenarios and Application Dates Chosen for PRZM/EXAMS modeling

Scenarios are used to specify soil, climatic, and agronomic inputs in PRZM, and are intended to result in high-end water concentrations associated with a particular crop and pesticide within a geographic region. Each PRZM scenario is specific to a location. Soil and agronomic data specific to the location are built into the scenario, and a specific climatic weather station providing 30 years of daily weather values is associated with the location. According to the chlorpropham problem formulation, there are no drinking water facilities downstream of the District of Columbia, so no drinking water assessment needs to be performed for the Gingko tree use. Therefore, the drinking water assessment is focused on the Easter lily use in Oregon and California. The ornamental nursery CANurserySTD and OR nurserySTD scenarios were used in modeling, along with the maximum proposed application rates. The previous drinking water assessment indicates that applications were made in May. Therefore, initial applications were assumed to occur on May 15.

Table 5. PWC 1.52 Inputs for the Chemical Tab for Residues of Chlorpropham plus 3-

chloroaniline

Parameter (units)	Input Value	Data Source	Comments
Organic-carbon Normalized Soil-water Distribution Coefficient (K_{oc}) in L/kg- $_{oc}$	33.3	MRID 40643901	Data for chlorpropham
Water Column Metabolism Half-life (day) and Temperature	0 (Stable) at 25°C	--	Stability assumed due to lack of aerobic aquatic metabolism data.
Benthic Metabolism Half-life (Days)	0 (Stable) at 25°C	--	Stability assumed due to lack of anaerobic aquatic metabolism data.
Aqueous Photolysis Half-life (days)	0 (Stable) at 40 Latitude	--	Stability assumed due to lack of aqueous photolysis data.
Hydrolysis Half-life	0 (Stable) at 25°C	MRID 00114729	--
Soil Half-Life (days)	15.9 at 20°C	MRIDs 49576601, 49961902	The 90 percent upper confidence limit on the mean of eight half-life values calculated for residues of chlorpropham and 3-chloroaniline.
Foliar Half-Life (days)	0	--	Default
Molecular Weight (g/mol)	213.66	MRID 42772401	MW for chlorpropham
Vapor Pressure (torr)	1.84×10^{-4}		
Solubility (mg/L)	165.5	MRID 42737401	
Air Diffusion Coefficient (cm^2/day)	0	--	Assumed a foliar application. Volatilization is only utilized for pre-emergent or bare ground applications.
Heat of Henry (J/mol)	0	--	

6 MODELING RESULTS

Estimated chlorpropham plus 3-chloroaniline concentrations in surface water and groundwater used for drinking water are summarized in **Table 6** and **7**, respectively. PWC predicted the highest EDWCs in groundwater for the foliar application with a single application of 4 lbs a.i./A per year. The maximum single-day concentration of chlorpropham plus 3-chloroaniline was 121 µg/L, and the associated post-breakthrough average concentration was 73.4 µg/L. The average simulation breakthrough time to the water table ranged from 1047 to 2739 days.

Table 6. Estimated Concentrations in Surface Water Source Drinking Water for Use on Easter Lilies

Single App. Rate lbs. a.i./A ^a (kg a.i./ha), # of applications, RTI, Application Method, Drift Fraction	Scenario Application Date (DD-MM)	EDWC in µg/L		
		Acute (Peak)	Chronic (Annual Average)	Cancer (Simulation Average)
Chlorpropham plus 3-Chloroaniline				

4 (4.4), 1x, above crop, ground (0.066)	CAnurserySTD_V2 (15-05)	82.5	64.4	46.3
	ORnurserySTD_V2 (15-05)	50.1	27.0	23.2
2 (2.2), 7x, 7 day, above crop, ground (0.066)	CAnurserySTD_V2 (15-05, 22-05)	81.9	64.4	46.3
	ORnurserySTD_V2 (15-05)	51.7	27.9	23.5

Abbreviations: App=Application; EDWC=estimated drinking water concentration

Table 7. Estimated Concentrations in Groundwater Source Drinking Water for Use on Easter Lilies

Use Site (Timing of App)	Single App. Rate lbs. a.i./A ^a (kg a.i./ha)	# of App	Ret. Int. Days	App. Type ⁶	EDWC in µg/L			
					Scenario	Acute (Peak	Chronic and Cancer (Post Breakthrough Ave)	Ave Breakthrough Time (Days)
Chlorpropham plus 3-Chloroaniline								
Foliar Application 15-5	4.0 (4.4)	1	--	Above Crop	Delmarva Sweet corn	43.5	23.8	1463
					FL Citrus	97.0	61.8	1047
					FL Potato	4.18	0.78	1058
					NC cotton	10.2	5.58	2262
					WI Corn	115.5	72.1	2739
					GA Peanuts	26.5	10.2	1641
Foliar Application 15-5	2.0 (2.2)	2	7	Above Crop	Delmarva Sweet corn	33.4	21.2	1463
					FL Citrus	81.0	58.3	1047
					FL Potato	4.64	0.83	1058
					NC cotton	12.1	6.54	2262
					WI Corn	121.0	73.4	2739
					GA Peanuts	28.9	11.0	1641

Abbreviations: App=Application; EDWC=estimated drinking water concentration; Ave=average

7 MONITORING DATA

The National Water Quality Portal was searched for monitoring data for chlorpropham and 3-chloroaniline on June 7, 2016 (USEPA and USGS, 2013). Chlorpropham was detected in 19% (68 of 349) of groundwater samples at a maximum concentration of 10 µg/L. Detections occurred in samples collected between 1987 and 1989 at a superfund site in Washington State. Non-

detects occurred in samples collected between 1988 and 1991 in Indiana. Chlorpropham was not detected, or was present at concentrations less than the method detection limit, which ranged from 12 to 30 µg/L in 1478 surface water samples collected in North Carolina. 3-chloroaniline was not an analyte included in the National Water Quality Portal.

8 DRINKING WATER TREATMENT

There is no information available about the effects of drinking water treatment on chlorpropham. The EDWCs in this assessment are representative of concentrations in drinking water source water (pre-treatment). For surface water, the conceptual model assumes that a pesticide reaches water via spray drift and/or surface runoff, and is instantaneously mixed throughout the receiving water body. Fate data show that chlorpropham is stable to hydrolysis. Therefore, chlorpropham will not degrade by hydrolysis during the time that elapses between intake of raw water and distribution of treated water to a consumer's tap. Photolysis data are not available for chlorpropham; therefore the effect on chlorpropham residues of ultraviolet light used as a means of disinfection, is unknown.

9 UNCERTAINTIES

There are a number of uncertainties associated with this drinking water exposure assessment. These uncertainties include high unextracted residues in the aerobic soil metabolism studies and the lack of other relevant, reliable environmental fate data (aerobic aquatic metabolism, anaerobic aquatic metabolism, aqueous photolysis, and sorption data).

The drinking water assessment is a screening-level assessment based on standard models and assumptions. The modeling assessment employs maximum use patterns and national default PCAs of one to reflect potential surface water and groundwater concentrations. To the extent that actual use patterns involve application of less a.i. than the permissible (labeled) maxima, aquatic concentrations could be lower than EDWCs reported herein.

10 LITERATURE CITED

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Appendix A. EPIWEB output

Chlorpropham

SMILES : CC(C)OC(=O)Nc1cccc(CL)c1

CHEM : Chlorpropham

MOL FOR: C10 H12 CL1 N1 O2

MOL WT : 213.67

Experimental Database Structure Match:

Name : CHLOROPHAM

CAS Num : 000101-21-3

Exp LogKoc: 2.6

Exp Ref : Schuurmann,G et al (2006); USDA Pest Prop DB

----- KOCWIN v2.00 Results -----

Koc Estimate from MCI:

First Order Molecular Connectivity Index : 6.575

Non-Corrected Log Koc (0.5213 MCI + 0.60) : 4.0275

Fragment Correction(s):

1 Nitrogen to non-fused aromatic ring ... : -0.5225

1 Carbamate (N-CO-O) or (N-CO-S) : -0.9601

Corrected Log Koc : 2.5449

Estimated Koc: 350.7 L/kg <=====

Koc Estimate from Log Kow:

Log Kow (experimental DB) : 3.51

Non-Corrected Log Koc (0.55313 logKow + 0.9251) : 2.8666

Fragment Correction(s):

1 Nitrogen to non-fused aromatic ring ... : -0.0216

1 Carbamate (N-CO-O) or (N-CO-S) : -0.0825

Corrected Log Koc : 2.7625

Estimated Koc: 578.7 L/kg <=====

3-chloroaniline

SMILES : Nc1cccc1CL

CHEM :

MOL FOR: C6 H6 CL1 N1

MOL WT : 127.57

----- KOCWIN v2.00 Results -----

Koc Estimate from MCI:

First Order Molecular Connectivity Index : 3.788
Non-Corrected Log Koc (0.5213 MCI + 0.60) : 2.5743
Fragment Correction(s):
 1 Nitrogen to non-fused aromatic ring ... : -0.5225
Corrected Log Koc : 2.0518

Estimated Koc: 112.7 L/kg <=====

Koc Estimate from Log Kow:

Log Kow (experimental DB) : 1.88
Non-Corrected Log Koc (0.55313 logKow + 0.9251) : 1.9650
Fragment Correction(s):
 1 Nitrogen to non-fused aromatic ring ... : -0.0216
Corrected Log Koc : 1.9434

Estimated Koc: 87.78 L/kg <=====

Appendix B. Modeling Output

Summary of Water Modeling of carbaryl 031017 and the USEPA Standard Reservoir

Estimated Environmental Concentrations for carbaryl 031017 are presented in Table 1 for the USEPA standard reservoir with the CANurserySTD_V2 field scenario. A graphical presentation of the year-to-year peaks is presented in Figure 1. These values were generated with the Pesticide Water Calculator (PWC), Version 1.52. Critical input values for the model are summarized in Tables 2 and 3.

This model estimates that about 0.58% of carbaryl 031017 applied to the field eventually reaches the water body. The main mechanism of transport from the field to the water body is by spray drift (71.4% of the total transport), followed by runoff (28.4%) and erosion (0.15%).

In the water body, pesticide dissipates with an effective water column half-life of 405.2 days. (This value does not include dissipation by transport to the benthic region; it includes only processes that result in removal of pesticide from the complete system.) The main source of dissipation in the water column is washout (effective average half-life = 695 days) followed by volatilization (971.7 days).

In the benthic region, pesticide is stable. Most of the pesticide in the benthic region (78%) is sorbed to sediment rather than in the pore water.

Table 1. Estimated Environmental Concentrations (ppb) for carbaryl 031017.

Peak (1-in-10 yr)	82.5
4-day Avg (1-in-10 yr)	82.2
21-day Avg (1-in-10 yr)	80.8
60-day Avg (1-in-10 yr)	78.8
365-day Avg (1-in-10 yr)	64.4
Entire Simulation Mean	46.3

Table 2. Summary of Model Inputs for carbaryl 031017.

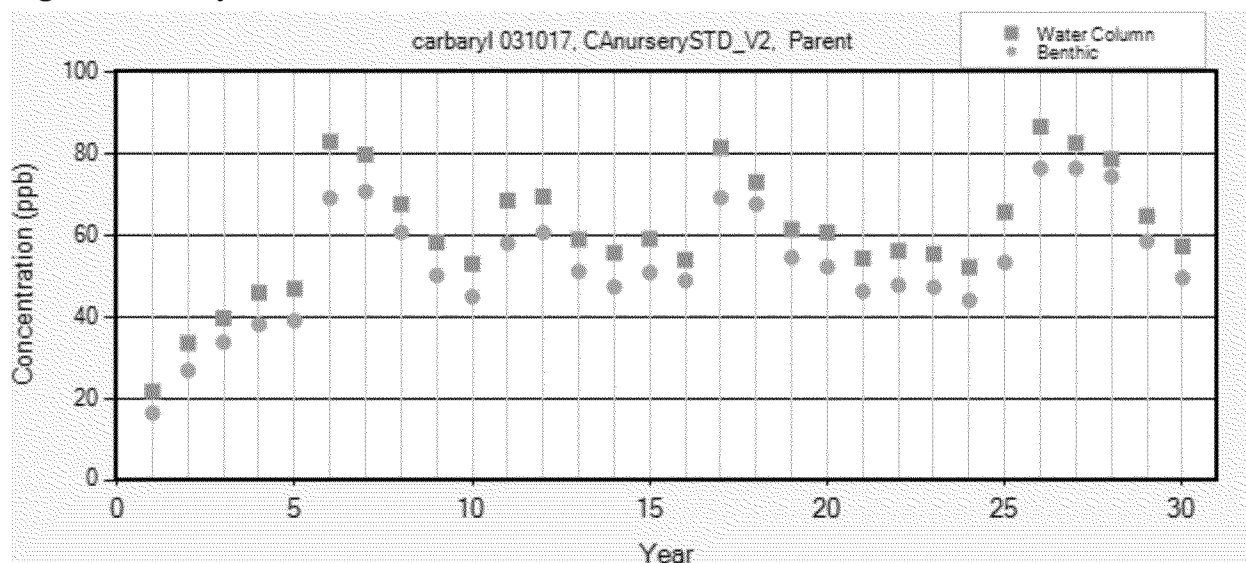
Scenario	CAnurserySTD_V2
Cropped Area Fraction	1.0
Koc (ml/g)	33.3
Water Half-Life (days) @ 25 °C	0
Benthic Half-Life (days) @ 25 °C	0

Photolysis Half-Life (days) @ 40 °Lat	0
Hydrolysis Half-Life (days)	0
Soil Half-Life (days) @ 25 °C	15.9
Foliar Half-Life (days)	0
Molecular Weight	213.66
Vapor Pressure (torr)	1.84e-4
Solubility (mg/l)	165.5
Henry's Constant	1.28E-05

Table 3. Application Schedule for carbaryl 031017.

Date (Mon/Day)	Type	Amount (kg/ha)	Eff.	Drift
5/15	Above Crop (Foliar)	4.4	0.95	0.135

Figure 1. Yearly Peak Concentrations



Appendix C. EFAST Modeling for Preliminary Exposure Estimates from Indoor Use Patterns

Exposure and Fate Assessment Screening Tool (EFAST version 2014) was used to estimate the potential concentrations of chlorpropham in water from indoor applications of chlorpropham to potatoes. Additional information on the EFAST model is available at <https://www.epa.gov/tsca-screening-tools/e-fast-exposure-and-fate-assessment-screening-tool-version-2014>. A market volume of 465,000 lbs chlorpropham (211,000 kg/year) was assumed based on the pounds of chlorpropham used on potatoes reported in the RED. It is acknowledged that this estimate is out of date. EPISUITE predicted a removal rate of 13.29% and this was also used as an input to the model. EFAST estimated an acute and chronic chlorpropham concentration of 4.44 µg/L. EFAST is a Tier I model that does not consider degradation or partitioning. The output file for EFAST is below.